EFFECTS OF RECOVERY PROGRAM ON HEMATOLOGICAL PARAMETERS AND CARDIORESPIRATORY VARIABLES OF UNIVERSITY LEVEL PLAYERS

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SYNOPSIS

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CHAPTER-I

INTRODUCTION

A group of elite athletes across Football, Tennis, Basketball, and Hockey exemplifies peak fitness, tactical mastery, and unwavering dedication. Their commitment to continual growth is reflected in training adaptability and recovery strategies. Active recovery methods like sub-maximal running and stretching help reduce soreness, enhance performance, and support long-term athletic development.

Recovery

Preparing and contest loads improve sports execution. During the time spent long haul preparing, the quantum of burden is steadily expanded and this prompts further developed execution. An amateur adjusts to preparing load quicker while with the expansion in preparing age, the higher burden is regulated and this outcome in more slow expansion in execution. A beginner adapts to training load faster whereas with the increase in training age, higher load are administered and this result in slower increase in performance. Sportsperson cannot effectively undertake very high loads of training unless proper means are adopted to accelerate the process of recovery. Sportspersons can't successfully embrace exceptionally high heaps of preparation except if legitimate means are taken on to speed up the course of recuperation. Controlling fitting means can guarantee speedier recuperation and make a game's individual fit for undertaking more continuous burdens. As contest in sports is turning out to be seriously difficult and requesting, utilizing powerful recuperation strategies for working with ideal athletic execution is principal to progress. The recuperation time frame has a fundamental impact on keeping up with competitors' physical, mental, and physiological prosperity and pivotal chasing after serious

actual preparation or rivalry and fulfilling execution. Recuperation for execution in sports presents procedures and modalities now used to upgrade competitors' recuperation, streamline preparation time and stay away from overtraining. Recuperation in the wake of preparation and rivalry permits competitors to get back to their typical physiological and mental state as quickly as could be expected. This is utilized so execution in the next contest or instructional course won't be unduly undermined by muscle touchiness and weariness. Static extending after practice is complimented as a deterrent measure for delayed onset muscle irritation and further developed a range of movement through a scattering of edema or pressure decrease of the muscle-ligament unit (Montgomery et al., 2008). Recuperation from preparing and rivalry loads demand a significant measure of investment. Recuperation can be partitioned into the following three stages:

Phase I

In this phase the onset of fatigue and recovery go on simultaneously i.e. when the training or competition is in progress. This process occurs because of resynthesize of ATP, CP, glycogen and some extent because of neutralization of lactic acid or blood lactate. Those activities which continue for a long duration and those sports which are played in considerable period, the pace of recovery in this phase plays an important role. Recovery during this phase, to large extant depends upon functional capacity and efficiency of different system and their organs of an athlete.

Phase II

This phase commences with the completion of the training schedule (cessation of physical activity) and ends with the restoration of homeostasis of the body. This phase lasts from few minutes to 2 to 3 hours. The following active recovery means can be adopted to make the recovery process faster.

1. Deep breathing exercises

2. Stretching exercises

3. Intake of drinks containing carbohydrates, vitamins, salts and minerals.

Phase III

The duration this phase of recovery can last from many hours to several days. In this phase, the recovery is facilitated by the anabolic process. Substance such as enzymes and proteins which get depleted in the process of undertaking the load get resynthesized.

The means which can be effective in accelerating recovery can be divided into following groups:

1) Training Methodology Related Means

2) Nutritional Means

3) Physio-therapeutic Means

4) Psychological Means

Training Methodology Related Means Among all the four-above group, these means are the most important for ensuring quick recovery. In fact, other means of recovery should support the training methodical means.

(i) Session of Training, training session should be carefully worked out for ensuring recovery. The following factor kept in mind:

(a) Warm up

A good session of warming up is essential for avoiding earlier onset of fatigue. Stretching exercise which form an essential part of a warm up session are effective in preventing stiffness and soreness in muscles

(b) Exercise Sequence

The exercise to be performed should be arranged in a sequence so that different muscle group, organs and systems are stressed in rotation. This sequence can help in delaying the onset of fatigue and guarantees quick recovery.

(c) Sequence of Performance

Tasks In addition to exercise, the performance tasks should also be arranged in a sequence. In a training session the speed, coordinative abilities and techniques should be developed first followed by strength. The endurance training should be at the end of the session.

(d) Phases of rest between repetition of load

Between repetitions of load, measured rest period should be provided in order to make the load effective and also make the sports person capable of completing the training schedule. Active rest pause (doing low intensity exercise during rest pauses) ensure faster recovery.

(e) Limbering Down

Every training session shall end with limbering down (cool down) which should be done for 10 to 20 minute in order to recovery and bring the body back to normal level of functioning. During limbering down, low intensity continuous exercise should be performed so as to quickly remove the metabolic product from muscles and blood

Cold Water Immersion

Cold water immersion is one kind of hydro-therapy. It is becoming a progressively popular recovery protocol, and has been confirmed to get better recovery for subjective measure, but its special effect on objective measure is far not much of visible. Although it is ability to improve recovery, the underneath psycho-physiological response of this recovery means are still not fully implicit. Finally, a

current study has reported that the best possible immersion duration is between 11-15 minutes. Recovery is a significant part of competition or training as it is used reduces the threat of heavy training and injury, even as promoting psychological and physiological willingness. This becomes mainly essential during intense training or competition to maintain a maximum state of performance. Appreciative its significance has lead to the use and improvement of much recovery technique such as foam rolling, massage treatment, electrical stimulation, whole body shaking, and compression of clothes, hyperbaric oxygen therapy, and cold water immersion therapy (including warm water and contrast bathing). For its capability to get better recovery time decrease the delay onset of muscles soreness (DOMS), cold water immersion therapy has admired recovery method among sports scientists.

Hematology

Hematology comes from the Greek word haima, meaning blood and logos, meaning study of science. So hematology is the science of blood. Hematology was practiced in various forms throughout history. Ancient Egyptian society used bloodletting technique in order to treat illness, which was the first recoded intense of hematological practice. In depth it is the study of blood and important part of clinical pathology and the diagnostic process. It includes not only the examination of the cellular and fluid position of blood, but also includes a study of the tissues that form store and circulate blood cells. A veterinaries use the results of hematology tests in help determine the health of an animal. These results are used in conjunction with the history, physical exam and other laboratory findings. Hemoglobin is a protein complex found in the red blood cell. A single red blood cell contains about 250 million hemoglobin molecules. Hemoglobin binds with oxygen. Every molecule of hemoglobin can bind with 4 molecules of oxygen. Thus, each RBC can bind up

billions of oxygen molecules. In normal healthy males, the hemoglobin ranges from 14.0 to 18.0 gms. 100 ml-1 of blood and from 12.0 to 16.0 gms 100ml-1 in healthy female. Hemoglobin plays a significant role in endurance events, as it is oxygen carrying compound that is delivered to the active tissue. During the exercise there is no change in total hemoglobin. The reason being, the RBCs that contain hemoglobin do not leave the capillaries during exercise. During exercise the degree of hemo-concentration or hemodilution determines the hemoglobin concentration. The hemoglobin will increase with hemo-concentration and falls with hemodilution. Following endurance training, the production of RBCs slightly increases. In turn, there is also a slight increase in the total hemoglobin. With an increase in plasma volume, the hemoglobin also get diluted due to this reason, some athletes in spite of having a normal hemoglobin levels, may appear to be anemic. Such a case can be treated by a period of rest for few days. During such period, the level of aldosterone returns to normal and the kidneys unload the extra sodium ions and water in the urine. A low level of hemoglobin denotes anemia. Endurance athletes are greater prone to anemia as they lose iron through sweat, faces, intestinal and bladder bleeding, and the poor absorption of iron (Haymes and Lamanea, 1989). In the females, especially, an additional loss of iron occurs during menstruation. Approximately one mg. Of iron is lost in the sweat and faces in both the sexes every day. Therefore, severe anemia may affect the VO2max and the endurance performance.

Blood Glucose

Glucose occurs freely in nature as well as in the combined form. It is present in sweet fruit and honey. Ripe grapes also contain glucose in large amount. Glucose is an aldohexose and is also known as dextrose. It is the monomer of many of the larger carbohydrates, namely starch, cellulose. It is probably the most abundant organic compound on earth. TerGlucose is correctly named as D (+)-glucose.'D' before the name of glucose represented the configuration whereas '(+)'represents dextrorotatory nature of the molecule. It may be remembered that 'D' and 'L' have no relation with the optical activity of the compound. Carbohydrates are utilized for energy, both instant and sustained. When insufficient carbohydrates are taken in, the body must utilize proteins for energy even to the point of catabolising muscles for energy. Digestive enzymes in the small intestines break down the carbohydrate into glucose. The glucose can be immediately utilized by the body or stored as glycogen in the muscles and liver. The muscles can store about 20 minutes of glycogen for energy. The bloodstream can hold about an hour of glucose for energy. If glucose levels are maximized and all glycogen storage location is full then the excess glucose is converted to fat by the liver and stored in adipose tissue or fat cell. There is really no limit to the amount of fat that a body can store. According to studies at the University of Massachusetts, carbohydrate is generally converted to fat the rate of 75% where 25% of the carbohydrates are used in the conversion process. There are three types of carbohydrates Monosaccharide, Disaccharides and Polysaccharides. Monosaccharide are simple sugars and are the basic unit of 24 carbohydrate. Examples of monosaccharide are glucose and fructose.

Consuming large amounts of sugar prior to exercise can actually inhibit performance. This produces a drastic increase in blood sugar. This causes the pancreas to secrete large amount of insulin to metabolize the sugar. All this insulin inhibits the metabolization of fat by the muscles. Therefore, the muscles rely more on glycogen, which is limited supply. The insulin reduces blood sugar level, which is already being reduced by the muscles utilization of glycogen stores for energy production. The blood sugar level reduces to a level, which may not only cause fatigue but dizziness as well. Therefore consumption of excess sugar prior to exercise reduces performance and endurance. Blood Lactate During high intensity exercise or competition which depends on a greater anaerobic energy production, the lactic acid accumulates in the blood to a maximal level. Where, in the presence of oxygen (aerobic metabolism) lactic acid does accumulate but not at maximal level. Therefore, the intensity of effort at which the blood lactate increase depends on the type of exercise being performed and is highly individual. During the competitive situation, the rate of lactate formation varies over the course of event an event e.g. A distance cyclist may have to exert much greater force on pedals when ascending a raise than when descending or covering level ground. Thus the lactate accumulates during the climb, to be metabolized during the subsequent descent. The trained subject produces less lactic acid during sub maximal exercise. This is so because he/she depends more on the aerobic metabolism due to the increased efficiency of skeletal muscles mitochondria.

Cardio respiratory parameter

Human physiology is the study of how the human body functions, with emphasis on specific cause –and-effect mechanism. Knowledge of these mechanisms has been obtained experimentally through applications of the scientific method. Physiology

is the study of biological function of how the body works, from cell to tissue, tissue to organ, organ to system, and of how the organism as a whole accomplishes particular tasks essential for life. In the study of physiology, the emphasis is on mechanisms with questions that begin with the world how and answers that involve cause –and-effect sequences. These sequences can be woven into larger and larger stories that include descriptions of the structures involved (anatomy) and that overlap with the sciences of chemistry and physics. The Greek philosopher Aristotle (384-322B.C.) speculated on the function of the human body, but another ancient Greek, Eras stratus (304-250? B.C.), is considered the father of physiology because he attempted to apply physical laws to the on the study of human function. Galan (A.D.130-201) wrote widely on the subject and was held as the supreme authority until the Renaissance. Physiology became a fully experimental science with the revolutionary work of the English physician William Harvey (1578-1657), who demonstrated the function of the heart and proved the circulation of the blood. However, the father of modern physiology is the French physiologist Claude Bernard (1813-1878), who observed that the milieu interior (internal environment) remains remarkably constant despite changing conditions in the external environment. In a book entitled The Wisdom of the Body, published in 1932, the American physiologist Walter Cannon (1871-1945) coined the term homeostasis to describe this internal constancy. Cannon further suggested that the many mechanisms of internal constancy.

Blood Pressure

The pressure exerted by the blood on the walls of the blood vessels is called blood pressure. It has two limits i.e., the upper limit called systolic pressure and the lower limit called the diastolic pressure. Systolic pressure is recoded when the blood is

ejected into the arteries during ventricular contractions (systole). The diastolic pressure is obtained when the blood drains from the arteries during ventricular relaxation (diastolic). In an adult, the systolic pressure ranges from 110-125mm Hg and diastolic pressure range from 65-80mm Hg. A blood pressure of 120/80mmHg is considered normal. However, several factors like age, sex, emotions, exercise, and disease affect blood pressure. With long duration aerobic exercise, the systolic blood pressure increases parallel with an increase in the intensity of exercise. The diastolic pressure does not change much. During static type of exercise (isometric contraction) there is an increase in the systolic as well as diastolic blood pressure. Such an increase perhaps occurs to increase the blood flow to be contracting muscles, that is caused by neural reflects arising in active muscles (Lind, et.al., 1966). Dynamic muscular work especially with arms above the waist level causes a greater increase in the blood pressure above the normal values. Such type of work should be avoided by the heart patient. The smaller vascular bed in the smaller muscles (arms) that exercise, creates an increased resistance to the blood flow that increases the blood pressure (Steinbeg, Astrand et al 1967). Soon after the completion of an exhaustive exercise, there is a significant fall in the systolic pressure. This is clearly observed when a subject exercises in a standing posture and the activity is stopped immediately. Pooling of blood in the dilated blood vessels of the leg muscles occur (venous Pooling). Following exercise, as the venous return towards the heart decreases, there is a decrease in the cardiac output as well. As a result, the blood pressure falls great extant. Such a drastic pressure may reduce the blood flow to the brain resulting in losing consciousness. In order to avoid such a situation, the intensity of exercise should be decreased for some time after the exercise is over. This helps in the redistribution of the blood flow from the active areas towards central circulation.

VO2 max.

VO2 max, or maximal oxygen uptake, is a common measurement allied to aerobic endurance that many athletes use to conclude they're on the whole fitness. VO2 max is the measurement of the maximum amount of oxygen that an individual can utilize during extreme, or maximal exercise. VO2 max is measured as milliliters of oxygen used in one minute per kilogram of body weight (ml/kg/min). It is one factor that may help find out an athlete's capacity to perform constant exercise. An athlete's VO2 max score is usually measured by exercise physiologists as one of the best indicators of the athlete's cardiovascular fitness and aerobic endurance. Hypothetically, the more oxygen you can use for the period of high-level exercise, the more adenosine triphosphate (ATP) energy you can create in your cells. This is frequently the case with elite endurance athletes, who classically have very high VO2 max values. VO2 max should not be perplexed with the lactate threshold (LT) or anaerobic threshold (AT), which pass on to the point for the period of exhaustive, all-out exercise at which lactate builds up in the muscles during exercise.

STATEMENT OF PROBLEM

The problem is entitled as Effects of recovery program on Hematological parameters and Cardiorespiratory variables of university level players.

OBJECTIVES OF THE STUDY

There are following objectives of the study.

1. To investigate how certain recovery programs affect players' Hematological variables.
2. To examine the impact of chosen recovery programs on the players' physiological characteristics.

3. To choose the player's recovery program from the three options that were given.

DELIMITATIONS

i. The study was delimited to 52 male mixed group players whose age ranged between 18-25 years.

ii. The study was delimited to three different recovery modules as experimental group namely Cold-Water Immersion group, Massage group and Low Intensity Stretching Group and a control group.

iii. The study was confined to three different recovery programs of 15 minutes duration immediately after the beep test.

iv. The study was further delimited to the following hematological and physiological variables:

Hematological Variables: Hemoglobin, Blood Glucose, lipid profile, Blood lactate, (Triglyceride, Cholesterol, H.D.L., L.D.L. and V.L.D.L.).

Physiological Variables: Blood Pressure (Systolic Blood Pressure and Diastolic Blood Pressure), VO2max

LIMITATIONS

I. The socioeconomic position of the respondents chosen for the study was viewed as a study limitation.
II. The inability to control climatic variables, such as changes in air and atmospheric pressure, relative humidity, and other factors, during the administration of treatments, tests, and measurements was acknowledged as a constraint.
III. It was acknowledged as a restriction that the subject's emotional states and motivating elements might affect the study's findings.

HYPOTHESIS

On the basis of the literature reviewed, expert's opinion and scholar's own understanding of the problem the following hypotheses is made:

H1: Three rehabilitation programs may have a considerable impact on mixed group players' hematological characteristics.

H2: Three rehabilitation programs may not have a considerable impact on mixed group players' physiological characteristics.

DEFINITIONS AND EXPLANATION OF TERMS

Recovery

Recovery is usually defined as that is, recurring something that was missing, or a reestablishment of the primary stage. However, recovery in sport, or from exercise is typically seen as returning what was lost (e.g. plummeting fatigue and re-establishing range of motion), and adapting (i.e. excellent reimbursement) to the compulsory training or competition demands.

Cold Water Immersion

Cold water immersion (CWI), or ice-bath, plunges pools and cold water therapy is a recovery process concerning the immersion of the body into cold water (≤15˚C/59˚F) instantly after exercise in an attempt to improve the recovery process. In spite of being shown to only have a small impact on recovery, cold water immersion has proven to be an effective method for enhancing recovery.

Hemoglobin

It is the respiratory pigments of erythrocytes. The color of blood is red due to hemoglobin. It contains globin, a protein which is conjugated with heme (hemoglobin= heme + globin). Heme molecule contains four pyrrole rings with iron in the center. The hemoglobin content of body is about 15 gm per 100 ml of blood.

Blood Glucose

The blood glucose level is the total of glucose in the blood. The Glucose is a sugar that comes from the foods we eat, and it's also produced and stored inside the body. It's the most important source of energy for the cells of our body, and it's carried to each cell through the bloodstream.

Blood Lactate

The Lactic acid that appears in the blood as a result of anaerobic metabolism when oxygen release to the tissues is insufficient to support metabolism. It’s throughout the Glycolytic System that the role and manufacture of blood lactate becomes apparent. Recollect the end product of glycolysis is pyruvic acid. When this is changed into lactic acid it rapidly dissociates and releases hydrogen ions. The enduring compound then combines with sodium or potassium ions to form a salt called lactate. Far from being a waste product, the formation of lactate allows for the persistent metabolism of glucose through glycolysis.

Lipid Profile

A pattern of lipids in the blood. A lipid profile generally includes the levels of total cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, and the calculated low-density lipoprotein (LDL) 'cholesterol.

Blood Pressure

Pressure that is exert by the blood upon the walls of the blood vessels and particularly arteries and that vary with the muscular competence of the heart, the blood volume and viscosity, the age and health of the individual, and the state of the vascular wall.

Systolic Blood Pressure

The blood pressure when the heart is contracting. It is purposely the utmost arterial pressure during contraction of the left ventricle of the heart. The instant at which ventricular contraction occurs is called systole. In a blood pressure analysis, the systolic pressure is normally the first number recorded. For example, with a blood pressure of 120/80 ("120 over 80"), the systolic pressure is 120. By "120" is meant 120 mm Hg (millimeters of mercury).

Diastolic Blood Pressure Diastolic:

Referring to the time when the heart is in a period of relaxation and dilatation (expansion). The noun for diastolic is diastole. (The final letter in "diastole" is pronounced as a long "e" as in "lee.") The diastolic pressure is distinctively the minimum arterial pressure during relaxation and dilatation of the ventricles of the heart when the ventricles fill with blood. In a blood pressure analysis, the diastolic

pressure is normally the second number recorded. For example, with a blood pressure of 120/80 ("120 over 80"), the diastolic pressure is 80. By "80" is meant 80 mm Hg (millimeters of mercury). A diastolic murmur is a heart murmur heard during diastole, the time the heart relaxes. "Diastolic" came from the Greek diastole meaning "a drawing apart." The term has been in use since the 16th century to indicate the phase of relaxation of the heart muscle.

VO2 max.

Maximum oxygen uptake (VO2max) is defined as the uppermost rate at which oxygen can be taken up and utilized by the body during rigorous exercises. It is one of the main variables in the field of exercise physiology and is commonly used to specify the cardio respiratory fitness of a human being

CHAPTER- II

REVIEW OF RELAED LITERATURE

Adele Broody et al (2017) the title of the study was "Acute effects of contrast water therapy and passive recovery on the physical and hematological parameters in male university rugby players". 23 university level rugby players were selected as a subject for the study. The subjects were participated in 15-minute intense fitness session. The cold-water therapy group alternated between warm water (40-42°C, 3 minute) and cold water (8-10 °C, 1 minute) during 20-minute recovery period but the passive recovery group did not participate in any recovery program. Physical and hematological were measure at baseline, 0 hours after fitness training, and at 0, 24, and 48 hours post recovery. The significant decrease the level of hemoglobin and blood lactate at ($p \leq 0.05$), whereas plasma glucose and partial oxygen level showed a significant increase from 0 to 24 hours in both groups. In cold water group six component (grip strength, VJT peak speed, VJT peak power, vertical jump test (VJT) height, blood lactate and hemoglobin) returned to baseline value 0 hours post cold-water therapy, whereas the passive recovery group showed at 0 hours in four components (grip strength, VJT peak speed, (VJT) height and blood lactate). Plasma glucose was restored after 24 hours for the cold-water therapy group, but in passive recovery group only demonstrated baseline values after 48 hours. A significant variance between the CWT and PAR groups at were showed in blood lactate and grip strength ($F(1, 21)>4$, $p\leq0.05$) at various time points. Compared to PAR, CWT caused larger percentage recovery in particular physical and hematological variables, which would suggest that CWT is better to PAR as an acute recovery modality.

Simon S. Young et al (2016) the title was selected by the researcher "effects of cold-water immersion on muscle oxygenation and performance during repeated bouts of fatiguing exercise in a group of healthy young adults" for the study.

Twenty healthy subjects selected for the study; they were performed two fatiguing bouts of maximal dynamic knee extension and flexion contraction both concentrically on an iso-kinetic dynamometer with a ten-minute recovery period in between. Repeated measure ANOVA analysis was used to asses treatment effects. The treatment group had significantly lower mean heart rate and lower skin temperature compared to the control group ($p<0.05$). Cold water immersion attenuated a reduction in tissue oxygenation in the second fatiguing bout by 4% when compared with control group. Muscles soreness was rated lower 1-day post-testing ($p<0.05$). However, cold water immersion had no significant effect on muscles performance in subsequent exercise

Lilianna Jaworska et al (2016) title of the study was "effect of progressive muscles relaxation on pressure pain threshold level and the effectiveness of the footballer's training". 32-football player were participated in the study. The subjects were engaging in a therapeutic program consist of 8 PMR session before and after apply pressure therapy. Dolorimeter was used to measure the pain threshold level in lumber region and to measure the footballer's endurance by Cooper test. PMR training did not increase significantly the pain threshold level in the experimental group($p>0.05$), but it raised significantly the distance covered in Cooper test ($p=0.04$). Analysis of the Spearman rank correlation was also carried out ($p=0.81$). In conclusions, PMR does not lower pain perception threshold. PMR therapy increases the distance measured by Cooper test.

Mehrzad Moghadasi et al (2014) the researcher worked on "effect different recovery method on the blood lactate level". 30 male table tennis players were selected as subjects for the study. They were divided into three groups (passive recovery group, active recovery group and cold-water immersion group), each group have 10 subjects. The Bruce test protocol was assigned to all groups to measure the blood lactate level in three stages. The results showed that the mean blood lactate during resting time and also immediately after the activity was not significant in all groups, but this amount was significant after doing different methods of recoveries between groups. Mean blood lactate reduction after recovery had the lowest amount in the passive recovery group, while it had the highest rate in CWI group. Our finding show that CWI have a significant effect on the reduction of blood lactate level ($p<0.05$). It can be concluded that active recovery has a better effect than passive mode in reducing the blood lactate level in athletes but no significant differences were observed. Moreover, method have a significant effect on the reduction of blood lactate rather than active and passive recoveries and are more effective method for reducing the blood lactate levels after exercise.

Calleja- Gonzalez J et al (2012) worked on "effect of sports massage and intermittent cold-water immersion on perceptual and performance markers of recovery by basketball players after competitive matches" Total 16 basketball players (8 male and 8 female) were selected as subjects. Massage, cold water immersion or control were applied after competitive matches, followed by the assessments of perceptual measures of recovery and physical performance countermovement jump and repeated sprint ability 24 h after the intervention. The result suggests that both massage and cold-water immersion improve perceptual measures of recovery. Furthermore, cold water immersion improves jump performance although neither such immersion nor massage had effect on repeated

sprint ability. This suggests that, overall, cold water immersion is more useful than massage in the recovery from basketball matches, especially in women.

CHAPTER- III

METHODOLOGY

In the present chapter Procedure and Methodology is given under headings, like, Selection of Subjects, selection of variables, administration of tests, description of administrations of test, criterion measures, data collection, tester reliability, tester competency & reliability of test, instrument reliability, administrations of recovery programs, experimental design of the study, procedure of data collection, procedure of data collection, statistical techniques. The details in respect of each one of them are given in the following in different captions.

SELECTION OF SUBJECTS

Mixed players from the LNIPE Gwalior, India, made up the study's population. The approach of purposeful sampling was utilized to choose the subjects. 52 male all India university level mixed group players with ages ranging from 18 to 25 years old were specifically chosen. Additionally, everyone was randomly assigned to one control group and three experimental groups (cold water immersion, massage, and low intensity stretching). Each group has 13 participants.

SELECTION OF VARIABLES

On the basis of available literature reviews and keeping in mind the feasibility criteria, the researcher selected the following variables for the present study:

(i) **Cardiorespiratory Variable**

a) Systolic Blood Pressure

b) Diastolic Blood Pressure

c) VO2max

(ii) **Hematological variables**

a) Hemoglobin

b) Blood Glucose level

c) Blood lactate

d) Lipid profile

1. Triglyceride

2. Cholesterol

3. Low Density Lipoprotein (L.D.L.)

4. High Density Lipoprotein (H.D.L)

5. Very Low-Density Lipoprotein (V.L.D.L.)

ADMINISTRATION OF TESTS

Maximum efforts and meticulous care to attain precision and accuracy in the measurements. Sophisticated instruments and standard procedures will be used to assess the performance on different variables.

Cardiorespiratory variables

Blood pressure and VO2max

Blood pressure

Sphygmomanometer and stethoscope and standard procedure were used for measuring blood pressure and scores was recorded in millimeter of Hg (Mm of Hg).

Volume of maximum oxygen (VO2max)

VO2max will be measured with the help of queens' college step test & the score will be recorded in milliliter per kilogram per minute (Ml/kg/min).

Hematological variables

Hemoglobin, Glucose, Blood lactate and Lipid profile.

For the hematological variables blood sample of each subject will be taken by a researcher from the radial artery & hemacytometer parameter will be used for taking blood and testing of blood sample will be done at LNIPE exercise physiology lab. Hemoglobin will be recorded in gram per deciliter, Blood Glucose will be recorded in milligrams per deciliter, Blood lactate will be recorded in mmol per liter and Lipid profile will be recorded in milligrams per deciliter.

DESCRIPTION OF ADMINISTRATIONS OF TEST

HEMATOLOGICAL VARIABLES

Hemoglobin, Blood Glucose, Blood Lactate and Lipid profile

Purpose: - To measure the Hemoglobin, Blood Glucose, Blood Lactate and Lipid profile

Procedure: - Subject will sit in comfortable position on a chair & keep the right arm on a table. A blood sample will be taken from the arm. The testing of blood will be done at exercise physiology laboratory in LNIPE GWALIOR.

Scoring: - Hemoglobin will be recorded in grams per deciliters.

1. Blood Glucose will be recorded in milligrams per deciliter.
2. Blood lactate recorded in mmol per liter.
3. Lipid profile will be recorded in milligrams per deciliter.

CARDIORESPIRATORY VARIABLE

Blood pressure

Purpose- To measure blood pressure

Requirements- sphygmomanometer, Stethoscope, Table, Chair, Record Note Book, Pen.

Procedure- The subject will be sitting on the chair in a comfortable position and stretch the left arm at mid chest level. Standardized blood pressure cuff will be used for measuring blood pressure. Cuff's bladder length will be appropriate and it will be nearly by 80% of the perimeter of upper arm. An inflatable cuff will be wrapped around the upper arm in such a position that its inflation compressed the brachial

artery. A stethoscope will be placed over the artery distal to the cuff and the cuff then inflated. researcher using the diaphragm or ring to measure the blood pressure. Cuff will quickly pump up approximately 180mmHg and air will be released from the cuff at a moderate rate (3mm/sec.). researcher with caution will watch sphygmomanometer and first knocking sound (Korotkoff) will be observed and recorded as systolic pressure of the subject. When knocking sound disappears then diastolic pressure of the subject will be recorded.

Maximum Rate of Oxygen Consumption (VO2 max)

Purpose - To measure Aerobic Power of mixed player.

Equipment required- A Stopwatch, 16.25 inches / 41.3 cm high Bench, Metronome or Tape Recorder, Stethoscope.

Procedure- First investigates or demonstrate the procedure for completing the VO2 max test with the help of bench. Metronome will be set with speed of 24 cycle (96 steps) per minute. On the signal "Go" at a time five subjects start up and down stepping in consonance with the sounds of metronome and by starting the stopwatch on 16.25 high bench. For each subject, a pulse count tester will be provided. On the first sound of metronome subjects placed their one foot on the bench, on second sound placed second foot on bench and after placing both the feet on the bench subjects stand straight with straightening the legs and back. As the subjects stand in erect posture on the third & fourth sound of metronome subjects step down in same sequence as in step up. For the duration of three minutes subjects repeated stepping up-up and down-down at the pace of 24 cycle (96 steps) per minutes. Investigator give the command stop as the subjects complete the test for the duration of three minutes. Pulse count tester record pulse of each subject after the five second of completion of test. Pulse count will be recorded for the fifteen second in standing position and multiplied by four to get per minute pulse count.

Scoring- For male below equation will be used to determine Maximum oxygen consumption: VO2 max = 111.33- (0.42 X step test pulse rate, beats per minutes)

DATA COLLECTION

For the present study data was collected by administering the standard test and procedure for selecting physiological and hematological variables. Before collecting data and giving recovery program, the purpose of study was told to all the subjects and participated voluntarily. Measurements of physiological and hematological variables were taken in the beginning of the session of beep test, after the test of training and after the experimental period of recovery. The experiment was conducted on the football field at Lakshmibai national institute of physical education, Gwalior. The test was conducted by a scholar under the guidance of professors at Lakshmibai National Institute of Physical Education, Gwalior. This study was not disturbed by any kind of examination or any other extracurricular activities.

ADMINISTRATIONS OF RECOVERY PROGRAMMES

COLD WATER IMMERSION

The subjects will play full-length of tennis match, after complete the tennis match immediately the subject will remove the cloth from the body and dip the whole body in cold water(10˚C). The face should be above the water surface. The subject should be shaking the all-body part slowly from top to bottom; no water activity will be allowed inside the pool. The temperature of water should be ≤15˚C. The subject's immersion in the cold water for 15 min only. During the time of water immersion if subject face any problem immediately ask them to come out from the cold water.

PRECAUTION AND CONTRAINDICATION

1. Cold Water Immersion Kills

2. Cold Water Immersion and Hypothermia

3. Initial Cold Shock

4. Short-Term Swim Failure
5. Long-Term Immersion Hypothermia

6. Post-Immersion Collapse

7. Shaking slurred speech, blurred vision

8. Bluish lips and fingernails

9. Loss of feeling in extremities

10. Cold and bluish skin

11. Confusion and Dizziness

12. Rigidity in extremities

13. Unconsciousness

14. Keep your head and neck out of the water.

15. Treating Victims of Cold-Water Immersion

16. Get the victim out of the water as soon as possible. Remove the victim from the water gently and in a horizontal position.

17. Prevent further heat loss.

18. Treat the hypothermia victim gently and to your level of training. Be prepared to provide basic life support.

19. Seek medical help immediately

EXPERIMENTAL DESIGN OF THE STUDY

Fifty-two volunteers from L.N.I.P.E were divided into four groups: three experimental groups—Cold Water Immersion (CWIG), Massage (MG), and Low Intensity Stretching (LISG)—and one control group, which did not undergo any recovery treatment. Each group included 13 participants. The experimental groups followed a 15-minute recovery regimen after the Beep test, while pre- and post-test data were collected. A randomized group design was used. The study aimed to assess the effectiveness of different recovery methods on physical performance.

PROCEDURE OF DATA COLLECTION

The researcher, with their supervisor, met team coaches to explain the study and gain approval. Players were informed about the study's purpose, and informed consent was obtained after addressing their questions. Physiological data were collected at three stages: before the study, after eight weeks, and at the end of twelve weeks. Data collection occurred on the football field, with accuracy ensured through the support of a medical practitioner.

- Data will be taken during recovery phase after observing the subjects for certain time period.
- Before the test, researcher will advise the subjects to avoid some food items and medicines.
- During test, blood will be drawn from a vein, usually from the arm region, and then tested in the physiology laboratory.
- 5ml blood will be taken and then store in a cold place for further testing.

STATISTICAL TECHNIQUE

In order to see the effect of recovery program that is Cold Water Immersion Group (CWIG), on cardiorespiratory parameters and hematological variables in tennis

player in India, descriptive statistics, 2x2 ANOVA with repetitive measure. since two groups (experimental group & control group) and two time (pre & post). statistical technique will be used and the level of significance will be set at 0.05.

STATISTICAL PROCEDURE

Descriptive Statistics will be employed with the help of SPSS 20.0 version. Level of significance will be set at 0.05.